Lesson 4: Drone Flight Academy 1

In this lesson, cadets will learn about drone controls and how to connect to the drone with their mobile devices. Cadets will fly their drones outside, using the PCB and cardboard arms that they made, and perform several test maneuvers. Cadets should take note of their flights in their flight logs.

Key Concepts:

- digital literacy - learning new software
- spatial perception and orientation
- problem solving

Objectives:

- Cadets will complete flight maneuver checklist.
- Cadets will take flight log notes.
- Cadets will become familiar with the pre-flight check procedure.

Instructor Background:

Flying Safety Recap

Review these safety procedures to the students again.

- Always keep a flying drone in sight. Don't lose track of the drone.
- Keep the drones off the ground when not in use (to prevent them from being stepped on).
- Always keep a clear flying zone.
    - Try to keep a 10 ft radius clear of people and objects while flying the drone
- Do not fly in adverse weather conditions, such as in high winds or reduced visibility.
    - Your Circuit Scribe Drone weighs 3.3 oz., making it light enough for wind to blow them away. A strong enough gust of wind can even blow your drone right at you or your cadets.
- Do not touch the motors after the drone has been in flight, as they may be hot to the touch.
- Never leave the battery plugged in for extended periods of time or overnight.
- The cadet in the "engineer" role must always turn off the drone before fixing or putting anything back together.

Group Member Roles

The cadets must have a Drone Learners Permit in order to fly. The Drone Permit proves that the student has went over and learned all the safety rules and mechanics of a drone from the previous lessons. Each member will have a chance to become a pilot and fly the drone (if time allows it), so cadet must have their own battery. The pilot uses their battery for their respective test flights. The role of the engineer is to fix the drone and put it back together in case the pilot crashes their drone. The cadet with the "Engineer" role must turn off the drone before conducting any maintenance. The cadet with the "Project Manager" is in charge of safety; they

must advise the pilot if they are getting too close to anyone or if the group breaks any safety rules.

Safety is the utmost priority for Circuit Scribe and it is the teacher's job to enforce safety and revoke any permits for the day if any safety rules are violated.

The roles are switched each time the drone battery dies. From a full charge, the battery lasts for approximately 5 minutes of constant flight time, not including any crashes or repairs.

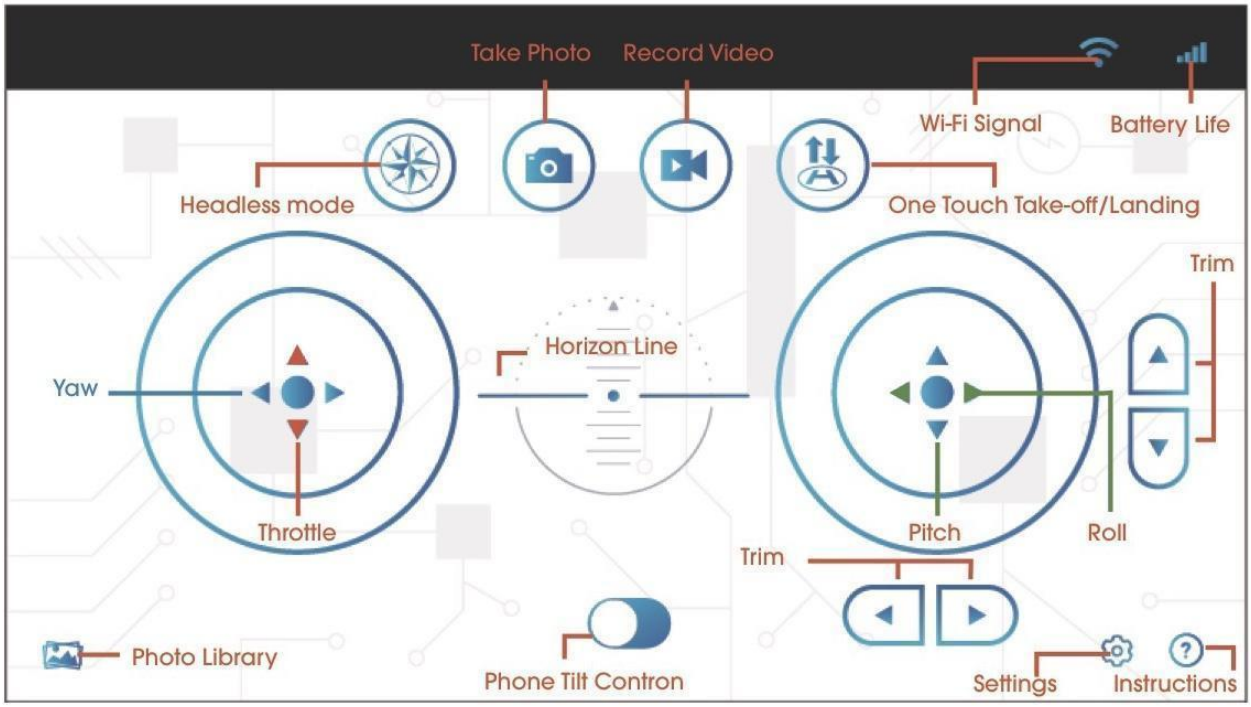
Drone Connection and Controls:

Connecting to the Drone

Before connecting to the drone, make sure the drone is built and the battery is installed in the drone hub. Install the 'CS Pilot' app in the iOS App Store or Android's Google Play Store. To turn on the drone, press and hold the black button underneath the drone until the RED LED is blinking.

Go to the phone's Wifi Settings and select the drone's Wifi Hotspot. Once connected, go to the 'CS Pilot' app. The RED LED should stop blinking when the 'CS Pilot app' is open and the drone is connected. If the RED LED keeps blinking, the battery may not be charged.

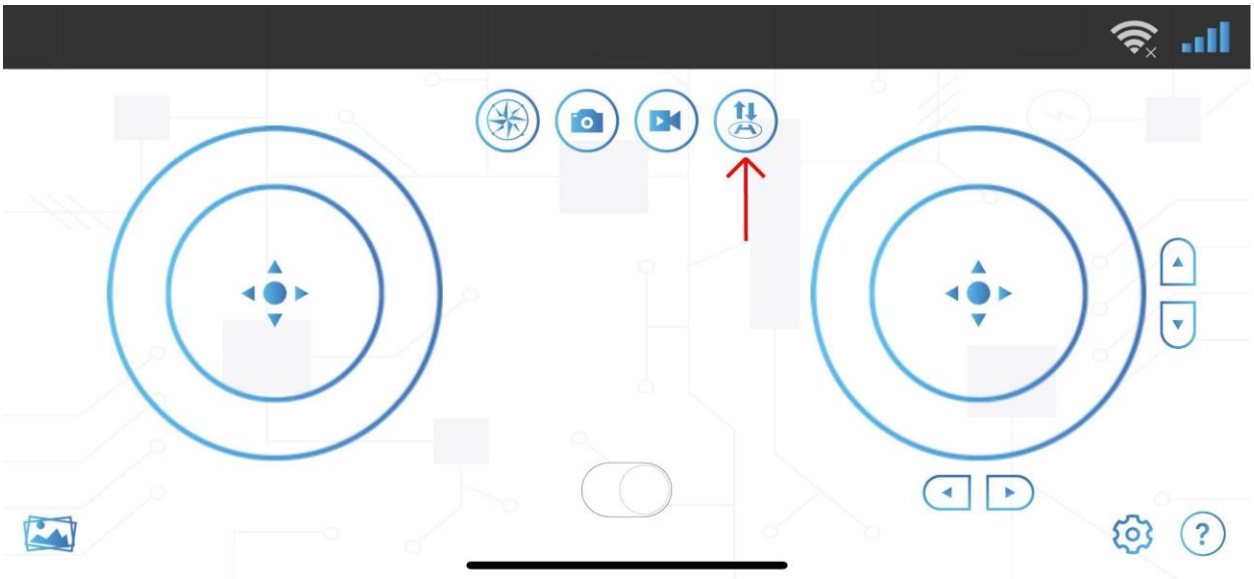
App Overview



Controlling the Drone

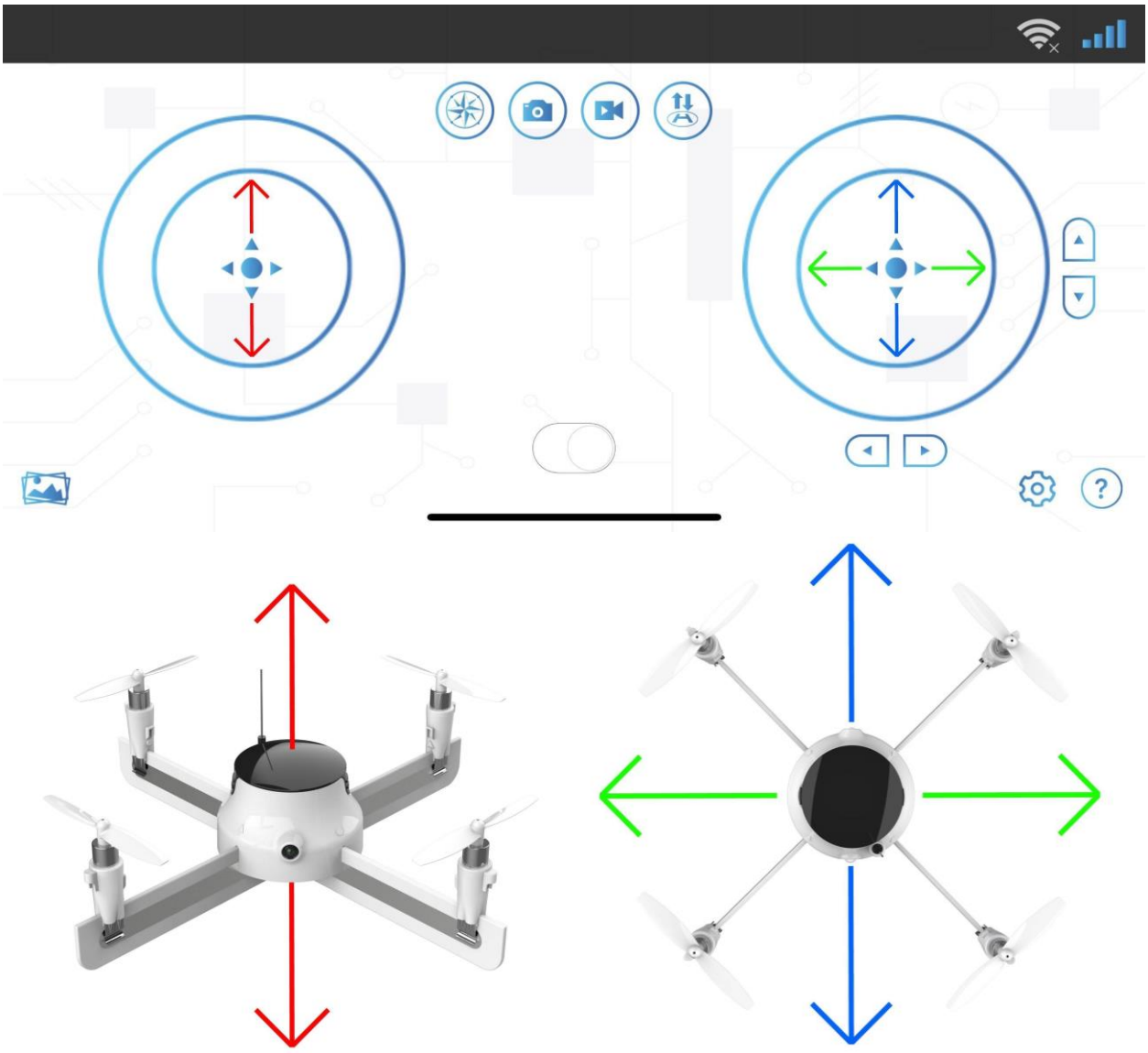
Place the drone in the fly zone with the RED LED facing the pilot. To turn on the drone, pull both joysticks to the bottom corners of the screen until the propellers begin to spin.

To lift off/land, press the takeoff/land icon which is the rightmost icon on the top center of the app.



To turn off the propellers, push both joysticks to the center of the screen.

The left joystick changes the yaw and altitude of the drone (up/down). The right joystick changes the pitch and roll (right, left, forward, backwards).



At the beginning of class, each group member needs to be randomly assigned a role assignment (engineer, pilot, project manager) to prevent any disputes within the group regarding who gets to fly first.

At this point, the cadets should have finished building the cardboard drone arms from Lesson 3. Have each group make their drone with the PCB or cardboard arms, depending on which day, and each group should have their flight log with them before heading outside for a test flight. Each cadet is responsible for their own battery.

To prevent any unauthorized drone flying in the classroom, the cadets must understand that turning on the drones in the middle of the classroom will result in their permit being revoked and will prevent them from flying for that lesson.

Pre-Flight Check Procedure
Before the flight test, the cadets should log the current conditions of the flying zone and the drone into the flight log. That includes the type of wing arms the drone is using, the weather conditions, and the length of the flight time.

Maneuver Lessons Day 1
Practice:

1. Turning on, taking off, landing, and then disarming the drone three times.
2. Moving the drone forward and backwards, left and right.
3. Flying around in a circle, free-flying the drone to get used to the controls.

Maneuver Lessons Day 2

1. Take off in the center of the fly zone then fly around the perimeter of the fly zone (from cone to cone) and land back at the center.
2. Fly in a circle while changing the altitude of the drone

Landing Procedure (End of Class/Lesson)
At the end of the lesson or class, each group should place the flight logs and other materials back into the portfolio. Have each group disassemble their drone for the next class period or lesson. The engineer of each group is in charge of collecting and charging the batteries at the designated charging station in the classroom.

Activity 1: Drone Flight Academy Day 1 (Outside)

Materials:

- Drone Permit
- Flight Log
- Constructed drone's PCB arms - **Day 1**
- Constructed drone's cardboard arms - **Day 2**
- Cones or indicating markers
- Timer/stopwatch
- Clipboard for flight log (optional)

Time:

30-45 min.

Description:

Cadets fly their drones with PCB/cardboard (Day 1/Day 2) arms after reviewing safety guidelines and the drone application in class.

Plan Ahead:

Designating a Fly Zone

For the most optimal flying conditions, find a flat, open field away from any cars, streets or obstacles. Using cones or indicating markers, place a cone at each corner of a 10x10 foot square. Make as many fly zones as there are groups and be sure to number them for each group. Be sure to keep the fly zones at a safe distance from any hazardous obstacles.

Avoid flying near any cars or a populated playground. The fly zones should be spaced out enough to prevent any rogue drones from crashing into other cadets.

Roles:

- Engineer – responsible for turning off the drone, which must be done before conducting any maintenance, fixing the drone and putting the drone back together, in case the pilot crashes their drone.
- Project Manager – responsible for safety. They advise the pilot if they are getting too close to anyone or if the group breaks any safety rules. They are also responsible for carrying the drone and necessary materials to the designated flying zone.
- Pilot - responsible for flying the drone and recording flight info into the flight log. They also complete a secondary safety check after being approved by the project manager and the pre-flight checklist.

Safety:

- Always keep a flying drone in sight. Don't lose track of the drone.
- Keep the drones off the ground when not in use to prevent from stepping on them.
- Always keep a clear flying zone.
    - Try to keep a 10 ft. radius clear of people and objects while flying the drone.

- Do not fly in adverse weather conditions such as in high winds or reduced visibility.
    - Your Circuit Scribe Drone weighs 3.3 oz., making it light enough for wind to blow them away. A strong enough gust of wind can even blow your drone right at you or your cadets.
- Do not touch the motors after the drone has been in flight, as it may be hot to the touch.
- Never leave the battery plugged in for extended periods of time or overnight.
- The engineer role must always turn off the drone before fixing or putting anything back together.

Step-by-step:

1. Assign starting roles for each group member.
2. Instruct the engineer to assemble their drone with the PCB arms. Instruct them to raise their hands when finished to check their work. Once their work has been checked, have them disassemble their drone.
3. Instruct the pilot to review the app use and the connecting instructions in their flight log.
4. Instruct the project manager to checkout their battery and prepare their flight log.
5. After 3-5 minutes, call an attention signal and have each role switch repeat until every student has completed each role.
6. Call an attention signal and review the safety guidelines again.
7. Go over the Drone Connection and Controls as a class.
    a.) Remind students that turning on the drone in the classroom will result in a penalty.
8. Practice the attention signal and continue outside to the designated flying zone.
9. Before having students split off in their groups to their flying zones, demonstrate the Pre-Flight Checklist and then the beginning practice maneuvers (i.e. takeoff/land, move around). Instruct students to change roles when their battery is drained.
10. Monitor students as they complete safety checks and their pre-flight checklist.
11. Monitor the groups and have them switch roles each time a battery dies.
12. At the end of the lesson, have the groups clean up their designated fly zones. Continue back to the classroom.
13. Instruct each group’s engineer to disassemble the drones and return them, the project manager to gather their group’s batteries and charge them at the designated charging station and the pilot to fill out any flight log information needed.

Discussion Questions: What was the most difficult part of flying the drone? How did you overcome that difficulty?

Quick Step-by-Step Overview of Lesson

Day 1

1. Assign roles for each group member.
2. Have the engineer assemble their drones with the **PCB** arms.
3. Go over safety again. More information can be found in the ‘Safety’ section.
4. Go over the Drone Connection and Controls section.
    a.) Remind students that turning on the drone in the classroom will result in a penalty.
5. Go over beginning practice maneuvers (i.e. takeoff/land, move around).
6. Make sure everyone meets the requirements in the checklist:
    a.) Students must have a permit to fly.
    b.) There must be designated fly zones set up outside; one for each group. More information on setting up a designated fly drone can be found in the ‘Designated Fly Zone’ section.
    c.) Students must fill in the Pre-Flight Checks in their flight logs before flying the drones.
7. Monitor the groups and have the roles switch each time a battery dies.
8. At the end of the lesson, clean up the designated fly zones.
9. Each group needs to disassemble the drones and the engineers need to gather their group’s batteries and charge it at the designated charging station.

Day 2

1. Re-assign the roles for each group member.
2. Have the engineer assemble their drones with the **cardboard** arms.
3. Go over safety again. More information can be found in the ‘Safety’ section.
4. Make sure everyone meets the requirements in the checklist:
    a.) Students must have a permit to fly.
    b.) There must be designated fly zones set up outside; one for each group. More information on setting up a designated fly drone can be found in the ‘Designated Fly Zone’ section.
    c.) Students must fill in the Pre-Flight Checks in their flight logs before flying the drones.
5. Monitor the groups and have the roles switch each time a battery dies.
6. At the end of the lesson, clean up the designated fly zones.
7. Each group needs to disassemble the drones and the engineers need to gather their group’s batteries and charge them at the designated charging station.
